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Rethinking the Career Landscape for Nicotine and Tobacco Trainees and Early Career Professionals

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Key Words

Career development, professional development, mentorship, tobacco, nicotine, smoking

Abstract

The last decade has included unprecedented economic, scientific, technological, and social changes that have made it necessary to reevaluate the type of career tracks available to trainees and early career professionals in nicotine and tobacco science. The goal of the present commentary is to reflect on our collective experiences as early career nicotine and tobacco scientists working in the United States, the United Kingdom, and the Netherlands in an effort to provide perspective on what we see as four key factors have been most influential with regards to science-related career planning in recent years: 1) employment opportunities (e.g., increasing number of graduate degrees and limited growth among traditional academic positions), 2) economic and financial considerations (e.g., shifts in research funding), 3) scientific and regulatory environments (e.g., changing regulation of tobacco products), and 4) clinical and social environments. Our commentary reviews the unique career opportunities that these factors have created for trainees and early career professionals including collaborative work across different research areas or science sectors (e.g., academia, government, and private sectors). In addition, career-related resources of value to early career scientists, as well as academic institutions, mentors, and professional organizations are provided. We are hopeful that increased discussion around the changes impacting nicotine and tobacco science in the 21st century can invigorate efforts to train scientists, promote diversity of thought, and facilitate the conduct and sharing of high quality nicotine and tobacco science inside and outside of the laboratory.

Implications

Unprecedented economic, scientific, technological, and social changes have made it necessary to reevaluate the type of career tracks available to trainees and early career professionals in nicotine and tobacco science. The acknowledgement that science career trajectories are evolving as we move into the 21st century can invigorate efforts to train scientists, promote diversity of thought, and facilitate the conduct and sharing of high quality nicotine and tobacco science inside and outside of the laboratory.

Introduction

Unprecedented economic, scientific, technological, and social changes have made it necessary to reevaluate the type of career tracks available to trainees and early career scientists and clinicians. The impact of these changes on science-related career tracks has been discussed more generally in recent years^{1,2}, but less so with respect to nicotine and tobacco science. The goal of the present commentary is to reflect on our collective experiences as early career nicotine and tobacco scientists working in the United States, the United Kingdom, and the Netherlands in order to provide information, resources, and additional considerations for trainees and early career scientists navigating careers in nicotine and tobacco science. We have identified four key developments that have impacted career planning in nicotine/tobacco science and each are discussed in greater detail below: 1) employment opportunities, 2) economic and financial challenges, 3) scientific and regulatory environments, and 4) clinical and social environments.

Key Developments in the Field of Nicotine and Tobacco Science

Education and Employment Opportunities

A 2012 survey of 130 members of SRNT found that the majority of trainees (85%) hoped to work in an academic setting.³ Similarly, 78% of respondents to a 2015 survey of trainees in Europe, Asia, and North America reported that they intended to pursue a research career in academia.⁴ Unfortunately, statistics suggest that there is a shortage of academic positions worldwide with graduate degrees being awarded at a far greater rate than the number of career opportunities in academia.^{2,5} The degree to which these shifts in training and traditional academic employment opportunities have impacted the field of nicotine and tobacco science is not clear at this time. However, our collective experience supports the idea that there has been growth in non-traditional career tracks outside of academia in nicotine and tobacco science due to changes in economic and regulatory environments, as noted below.

Economic and Financial Considerations

Despite large investments in science from many private and public organizations over the past century,^{6,7} the economic downturn in the early 2000s and other factors have had a considerable impact on research funding. For example, the leading public funder of biomedical research in the world, the US National Institutes of Health⁷ (NIH), has seen a 13.4% reduction in budget (adjusted for inflation) across the last ten years according to estimates from the American Association for the Advancement of Science.⁸ However, in the US during the same period of time a new source of funding for nicotine and tobacco research was established by the passing of the 2009 Tobacco Control Act (TCA). The TCA established the Center for Tobacco Products (CTPs) and called for funding of CTP-related activities including the Tobacco Centers of Regulatory Science (TCORS) via tobacco company user fees rather than through discretionary spending of which supports NIH-related funding. Due to this unique arrangement the CTP and

related Tobacco Regulatory Science (TRS) research is funded for the foreseeable future unless there is an act of Congress that would change the TCA. Coinciding with shifts in funding is the reality of rising higher education costs and student loan burden faced by many trainees.⁹ These economic and financial changes have the potential to influence not only the funding environment of nicotine and tobacco scientists, but also the work environment given that restricted funding or student loan burden combined with institutional requirements can create an increasingly stressful and hypercompetitive work environment for scientists.¹⁰ We were unable to find any published literature addressing the impact of the above economic factors on nicotine and tobacco research, but our personal experience confirms that such factors play an important role in the career planning of trainees and early career professionals.

Scientific and Regulatory Environment

Collaborative and Global Research Efforts. There has been a push for biomedical research to become more collaborative in recent years with a shift away from smaller research groups to larger scale projects involving global research teams across a variety of academic, government, and private sector stakeholders.^{1,6} Such collaborations are reflected by the recent announcement of a state-of-the-art, industrial-scale brain imaging hub in China which will permit scientists across the world to collaboratively map neural connectivity in mice and humans.¹¹ Similarly, with respect to nicotine and tobacco research, collaborative efforts to improve tobacco control efforts on a global level have been emphasized, especially in regions such as low- and middle-income countries.¹² Impactful collaborative efforts are also represented by The International Tobacco Control Policy Evaluation Project (<http://www.itcproject.org>) which was initiated in the early 2000s as the first-ever international cohort study of tobacco use.

Research Ethics and Scientific Integrity. Regulatory requirements for research ethics protection in the form of Institutional Review Boards (IRBs) or Ethics Review Boards have been increasing in the last two decades in some parts of the world.¹³ These requirements, while necessary and important, have contributed to unique challenges faced by researchers and IRBs including demands on time and resources in order to review applications and meet requirements. Relatedly, unique challenges to scientific integrity have evolved over the last decade. Some scientists have suggested that the publish or perish mentality of science, combined with intense competition for research funding has created a “perverse incentive system” that contributes to unethical research practices.¹⁰ With respect to the nicotine and tobacco field, there are evolving non-financial and financial conflicts of interest with the potential to influence science due to changes in tobacco products and regulation. Such changes necessitate an emphasis on training in scientific integrity, as noted in a recent paper on mentorship in tobacco regulatory science.¹⁴ The result of these and other demands on scientists can contribute to issues such as data falsification, ‘p-hacking’ or ‘spinning’ of research findings, faked peer review, predatory publishers, and more broadly a ‘reproducibility crisis’ for research findings.¹⁵ One approach for addressing these challenges has included the

creation of on-line resources for tracking unethical publishing behavior. (e.g., the official US channel of the Office of Research Integrity, www.ori.hhs.gov, as well as unofficial channels: www.retractionwatch.com and <http://beallslist.weebly.com/>). Other initiatives include a move to open science practices which emphasize transparency and reproducibility of scholarly research, as well reforming the peer-review process with efforts such as pre- and/or post- publication review of manuscripts (e.g., PubMed Commons) .¹⁵

Technological Innovation. Although rates of smoking have declined in some countries, they remain high in many developing countries and for some populations making the need for innovative research to reduce smoking rates an urgent public health priority.¹⁶ The development of new, approved medications for the treatment of tobacco dependence has lagged since the advent of varenicline as a prescribed treatment in the early 2000s. In contrast, the availability of novel tobacco-related products such as electronic cigarettes has increased in recent years and the role that these devices will play in tobacco dependence has been debated.¹⁷ Innovative research methods have also evolved over the last decade to include web- and cloud-based access to data sources such as electronic medical records (EMR) and “smart” devices, as well as crowdsourcing for data collection and research funding (e.g., Mechanical Turk, <https://www.mturk.com/mturk/welcome>). These new products and research strategies offer exciting opportunities for early career scientists hoping to find a niche in the field of nicotine and tobacco science inside or outside the laboratory, including those that are interested in regulatory science.^{14,18}

Clinical and Social Environment

Major changes within the field of nicotine and tobacco science have also occurred within the clinical/healthcare environment. Reimbursement rates have not kept pace with inflation and time demands for non-billable activities (e.g. documentation) have continued to increase. Concurrently, the increased integration of behavioral health into primary care settings is a promising avenue for achieving better access to smoking cessation services and other preventative care for tobacco use, though one that comes with many challenges.¹⁹ Additionally, the last two decades have also seen an increase in awareness of social issues impacting scientific and clinical environments such as issues related to diversity, social justice, and equity in the careers and research activities of scientists and clinicians.^{20,21,22} For example, a recent analysis of NIH R01 funding noted that fewer awards were received or applied for by women of color as compared to white men and women indicative of NIH funding gaps related to gender and race/ethnicity.²² Such concerns build on growing concerns related to the “leaky pipeline” concept that is characterized by women in science, technology, engineering, and mathematics (STEM)-related occupations being more likely to leave their field compared to other professional fields of study. Psychology-related fields such as nicotine and tobacco science might be particularly impacted by such issues given the high numbers of women earning doctorate degrees relative to men in recent years.

Career Planning for Trainees and Early Career Professionals

As depicted in Figure 1, there are a variety of career trajectories available to trainees and early career professionals across the varying stakeholders that influence and drive nicotine and tobacco and tobacco science (e.g., Academia, Government, Private). There is substantial overlap among many of these trajectories and they do not necessarily represent discrete paths. For example, clinicians can concurrently conduct clinical hours as well as university-level research, while individuals in the private sector may hold adjunct teaching positions at academic institutions. As noted previously, collaborative work in science is becoming increasingly important and unique approaches to working collaboratively highlight the exciting opportunities available to early career scientists and clinicians as they move forward in their careers. As noted in a recent publication addressing neuroscience training in the 21st century, “Training in teams that include biotechnology or industry partners, clinicians, patient advocates, experts in regulatory affairs, and bioethicists, among others, would foster more successful translation from the bench than in the past.”¹ Such findings correspond to results from a qualitative analysis of mentoring in the field of TRS in which early career TRS professionals emphasized their need to “develop and nurture a broad professional network across scientific fields and disciplines.”^{14p.7} Along these lines, trainees and early career professionals looking to diversify their training on their own initiative might find the additional resources listed in Table 1 helpful. Table 1 includes hyperlinks associated with a range of topics including careers inside and outside of academia, career planning, funding, fellowships, law/regulation/policy, and medical writing. While Table 1 does not include an exhaustive list of available resources, it does give an overview of the varied and unique opportunities that are available to the highly trained professionals such as those in the field of nicotine and tobacco science. Ideally, the content in Figure 1 and Table 1 can prompt mentors, professional organizations, and other influential decision makers to incorporate these varied opportunities into training and career-related guidance.

Future Directions and Recommendations

As summarized in this commentary, the evolving career landscape of scientists in general, as well as nicotine/tobacco scientists and clinicians, has created unique opportunities for trainees and early career professionals in nicotine/tobacco science. We consider our commentary a call to action for those involved in the field of nicotine and tobacco science to consider the impact that these factors described in our commentary will have on nicotine/tobacco science in the 21st century. For trainees and early career professionals we recommend the following: 1) Understand and monitor the various factors impacting nicotine/tobacco science in the 21st century (e.g., trends in employment or funding), 2) Seek out opportunities to interact/work with individuals from various distinct career paths, including those outside traditional settings (e.g. academia), 3) Critically evaluate your unique skillsets to determine those that set you apart from others in the field and seek out supplemental training accordingly (e.g., advanced training in particular statistical methods), 4) Determine what aspects of your

work as a researcher and/or clinician that have been most rewarding and engaging, and look for careers that best align with those interests and values.

In addition, those involved in the training of our next generation of nicotine and tobacco scientists, such as mentors, institutions, and professional organizations, should consider the possibility that some trainees will opt-out of the “traditional” academic career track. Such a choice might be due to a variety of reasons including unique skillsets that are better served in non-academic positions, economic constraints including funding cuts, as well as the evolving nature of the job market including new career opportunities in nicotine/tobacco science (e.g. government positions in regulatory science, tech-sector jobs). Efforts to offer career support that take into account these changes include connecting trainees with early career professionals, as exemplified in recent years by the Trainee Network Advisory Board of SRNT^{3,23}, organizing career panels that represent diverse career options, and providing interdisciplinary training inside and outside of academia, as suggested by a recent National Institutes of Health Biomedical Research Workforce Working Group Report.²⁴

Our review of the literature also highlighted important topics that have yet to be explored within the field of nicotine and tobacco science as they pertain to training and career planning. For example, it is unclear if the observed reductions in research funding seen more generally for science are also being observed by early career nicotine and tobacco scientists/clinicians. As noted, it could be the case in the US that NIH funding cuts have been offset by increased funding from FDA/CTP. While this added source of funding is no doubt a net positive for junior investigators seeking support for their research, it does constrain research to that related to TRS and thus could alter the research landscape generated by our next cohort of nicotine/tobacco researchers. Similarly, concerns related to research ethics that have been discussed more broadly for science including the lack of reproducibility of many research findings¹⁴ have not been fully explored in the published literature on nicotine and tobacco. More attention to these and other factors impacting the future of nicotine and tobacco science will be invaluable for informing trainees and early career professionals in the field.

A last point to emphasize is generalizability of our commentary suggestions. While our training and career experiences in the US and EU are representative of the majority of members in the Society for Research on Nicotine and Tobacco (SRNT; approximately 81% of SRNT members are employed in these regions according to M. Johnson personal communication, August 4, 2017), we are sensitive to the fact that there are unique and varying challenges faced by early career scientists throughout the world. Trainees’ and early career professionals’ goals and needs will likely vary geographically and culturally, and career advice should respect these differences.⁴ For example, expectations of PhD students might vary by geographic region as demonstrated by PhD graduate training lasting longer on average in the US compared to the UK (e.g., 5-6 years compared to 3-4 years). In addition, nicotine/tobacco policy varies considerably depending on geography and such variation can impact training and employment opportunities. However, despite such variation in training, we are hopeful that our

perspectives will provide a starting point for further discussion on careers in nicotine and tobacco science on a global level. Overall, the acknowledgement that science career trajectories are evolving as we move into the 21st century can invigorate efforts to train scientists, promote diversity of thought, and facilitate the conduct and sharing of high quality nicotine and tobacco science inside and outside of the laboratory.

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Declaration of Interest

BAK is an employee of PinneyAssociates. In the past three years PinneyAssociates has provided services for NJOY, Inc., a developer and marketer of electronic nicotine delivery systems, and since February 2015, for Reynolds American, Inc. on tobacco harm minimization. RAI was recently acquired by British American Tobacco (BAT). PinneyAssociates work for RAI focuses on products, regulations, and policies related to smoking cessation and harm minimization; PinneyAssociates does not work on combustible conventional cigarettes. RAI had no input in to any facet of this work, from its conception, analysis, writing, nor submission.

Table 1. Overview of Career-Related Resources in the Field of Nicotine/Tobacco Science

| Topic Area | Weblink/URL |
|------------------------------------|--|
| Careers in Academia | http://www.apa.org/monitor/2017/10/academic-job.aspx https://edgeforscholars.org/ |
| Careers Outside of Academia | http://blogs.nature.com/naturejobs/2013/05/21/careers-for-scientists-away-from-the-bench/ http://www.sciencemag.org/sites/default/files/documents/away_from_the_bench_1.pdf |
| Career Planning | http://myidp.sciencecareers.org/ http://www.apa.org/education/grad/individual-development-plan.aspx https://globalhealthtrainingcentre.tghn.org/elearning/ |

Funding Opportunities

<https://www.mrc.ac.uk/skills-careers/interactive-career-framework/#?funderview>

<https://pivot.cos.com/>

<https://www.nsf.gov/funding/>

https://grants.nih.gov/grants/guide/search_guide.htm

**Science & Technology
Fellowships**

<https://www.aaas.org/program/science-technology-policy-fellowships>

<https://www.aaas.org/page/about-1?et rid=330134252&et cid=1589855>

Law, Regulation, and Policy

<https://www.fdli.org/>

<https://www.hri.global/>

<http://www.sciencemag.org/careers/2009/10/finding-your-way-policy-careers-europe>

Medical Writing

<https://www.amwa.org/>

<https://www.emwa.org/>

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